JP-06-160871E

[Title of the Invention] LIQUID CRYATAL DISPLAY PANEL AND METHOD FOR PRODUCING THE SAME

[Abstract]

[Object] There is provided a liquid crystal display panel which can be formed by a simple process and can improve the reliability and durability of the liquid crystal display panel and a method for producing the same.

[Solving Means] This liquid crystal display panel has the constitution formed by joining the peripheral edges of two substrates having at least electrodes by means of at least two kinds of sealing materials and holding a liquid crystal between these two substrates. Of these sealing materials, at least the sealing material for hermetically sealing the liquid crystal by directly contacting with the liquid crystal is viscous fluid 13 inert to the liquid crystal and at least one kind of adhesive sealing materials 14 are formed in order to hold the substrate 12 to the outer side of the viscous fluid 13. The viscous fluid 13 inert to the liquid crystal is disposed for the sealing material contacting the liquid crystal 11, by which the liquid crystal characteristics is not deteriorated when producing the liquid crystal display panel and the reliability of the display characteristics of the liquid crystal display panel is enhanced. The margin for controlling the amount of the

liquid crystal to be dropped is widened by hermetically sealing the liquid crystal with the viscous fluid 13.

[Claims]

[Claim 1] A liquid crystal display panel in which the peripheral edges of two substrates having electrodes are joined by means of at least two kinds of sealing materials and a liquid crystal is held between these two substrates, wherein, of these sealing materials, at least the sealing material for hermetically sealing the liquid crystal by directly contacting with the liquid crystal is viscous fluid inert to the liquid crystal and adhesive sealing materials are formed in order to hold the substrate to the outer side of the viscous fluid.

[Claim 2] The liquid crystal display panel according to Claim 1, wherein the viscous fluid consists of silicon resin or fluorocarbon resin.

[Claim 3] A method for producing a liquid crystal display panel, comprising:

providing viscous fluid to peripheral edge of one of two substrates having electrodes;

dropping a liquid crystal on the substrate by a predetermined amount;

joining the two substrates in vacuum; and

coating and curing at least one kind of adhesive resin

on the periphery of the viscous fluid.

[Claim 4] The method according to Claim 3, wherein the viscous fluid is mixed with spacers for determining the gap of the liquid crystal display panel.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

The present invention relates to a liquid crystal display panel which can be widely in a pocket TV, various kinds of instruments, and a display for a notebook-type personal computer because it has light weight and low power consumption among OA display devices, and a method for producing the same.

[0002]

[Description of the Related Art]

A liquid crystal display panel has the construction which a liquid crystal is inserted between two electrode substrates at an interval of several μm to several tens μm and peripheral edges of the electrode substrates are hermitically sealed with organic resin. As this sealing material, thermosetting resin or photo-curing type resin is used in view of reliability and workability.

[0003]

In a method for producing the liquid crystal display

panel, generally, as shown in Fig. 3, there is a vacuum injecting method including: (a) printing a thermosetting or photo-curing type sealing material 32 so that a substrate 31 has an injecting port, (b) joining two electrode substrates 31 and 33 and curing the sealing material 32 to form empty panel, (c) injecting a liquid crystal 34 into the injecting port in vacuum, and (d) hermetically sealing the injecting port with sealing resin 35. However, in this method, due to the viscosity of the liquid crystal and a narrow gap of the empty panel which is previously produced, the injection speed of the liquid crystal is low. Accordingly, the injecting time becomes long as the screen size of the panel increases and thus the productivity is deteriorated. Further, in this method, a process for sealing the injecting port which is wet by the liquid crystal is required. Accordingly, in order to improve the productivity and simplify the process, as shown in Fig. 4, there is provided a drop injecting method including: (a) screen-printing photo-curing type sealing material 42 onto one substrate 41 (an injecting port is not provided), (b) dropping a predetermined amounts of the liquid crystal 43 on the substrate 41, (c) joining two substrates 41 and 44 in vacuum, and (d) covering a display portion with a mask 45 so that light is not irradiated to the display portion and curing photo-curing type sealing material 42 by light radiation.

[0004]

[Problems to be Solved by the Invention]

However, in the drop injecting method, when joining the substrates, the non-cured sealing material contacts with the liquid crystal, thereby adversely affecting the liquid crystal. Also, the photo-curing type resin has adhesive force lower than that of the thermosetting resin, shock is generated or reliability of long term is deteriorated. Thereby, the photo-curing type resin having strong adhesive force has been developed. However, if the resin having adhesive force is used, the influence on the liquid crystal increases. In order to solve this problem, for example, there is provide a method of combining double seal construction in which photo-curing type resin having small influence on the liquid crystal is used in the inner side contacting with the liquid crystal and photo-curing type resin having strong adhesive force is used in the outer side thereof. Alternatively, as disclosed in Japanese Unexamined Patent Application Publication No. 2-228626, there is a method of forming a frame having small influence on the liquid crystal and then providing adhesive resin to the outer side thereof to join the substrates. However, in any case, since the sealing material contacts with the liquid crystal, the light required for curing the photo-curing type sealing material is necessarily irradiated to the liquid

crystal adjacent to the sealing material and thus the liquid crystal characteristics is deteriorated. Also, in the latter case, a high-precision process for uniformly forming the frame inert to the liquid crystal with a height of several μm which is required for forming a gap is required.

[0005]

Further, in the drop injecting method, the amount of the liquid crystal to be dropped must be precisely controlled. That is, in case that the liquid crystal is dropped in the quantity greater than the volume of the cell formed by the both substrates and the sealing material, the gap of the joined panel becomes greater than a predetermined gap or excess liquid crystal flows out. Also, in case that the liquid crystal is dropped in the quantity less than the cell volume, air void is generated by the lack of the liquid crystal, because the substrate interval is held by the spacers and can not be reduced. Accordingly, the amount of the liquid crystal to be dropped must be precisely controlled.

[0006]

In order to solve the above-mentioned problems, an object of the present invention is to provide a method for producing a liquid crystal display panel which can simplify the process, enhance the reliability and durability of the panel, and widen the margin for controlling the amount of

the liquid crystal to be dropped while sealing material does not affect the liquid crystal, in a drop injecting method which can producing the liquid crystal display panel with good productivity. Also, another object of the present invention is to provide a liquid crystal display panel having new construction.

[0007]

[Means for Solving the Problems]

In order to accomplish the above-mentioned objects, the present invention provides a liquid crystal display panel in which the peripheral edges of two substrates having electrodes are joined by means of at least two kinds of sealing materials and liquid crystal is held between these two substrates. Of these sealing materials, at least the sealing material for hermetically sealing the liquid crystal by directly contacting with the liquid crystal is viscous fluid inert to the liquid crystal and adhesive sealing materials are formed in order to hold the substrate to the outer side of the viscous fluid.

[0008]

Furthermore, the present invention provides a method for producing a liquid crystal display panel, comprising: providing viscous fluid to peripheral edge of one of two substrates having electrodes; dropping liquid crystal on the substrate by a predetermined amount; joining the two

substrates in vacuum; and coating and curing at least one kind of adhesive resin on the periphery of the viscous fluid.

[0009]

[Operation]

In the liquid crystal display panel of the present invention, by using viscous fluid which has chemical resistance and is not chemically changed before and after producing the panel, the characteristics of the liquid crystal can be suppressed from being deteriorated and thus the reliability of the display characteristics of the liquid crystal display panel is enhanced.

[0010]

Furthermore, since the dropped liquid crystal is sealed by the viscous fluid when joining the substrates, the margin for controlling the liquid crystal to be dropped is widened. Also, since the liquid crystal is hermetically sealed by the viscous fluid which is chemically stable, adhesive resin having strong adhesive force and good processibility can be used and thus the process of curing the sealing material can be simplified. Moreover, since an adhesive containing solvent having strong influence on the liquid crystal or a reinforcing agent such as a silane coupling agent can be used, the durability of the panel is enhanced.

[0011]

[Embodiments]

A liquid crystal display panel and a method for producing the same according to present invention will be further illustrated with reference to the attached drawings.

[0012]

An embodiment of the present invention will be described with reference to the attached drawings. Fig. 1 is a cross-sectional view of a liquid crystal display panel according to an embodiment of the present invention. A transparent electrode such as indium tin oxide or a thin film transistor layer (not shown) is formed on the surface of the panel and an alignment layer (not shown) such as polyimide is formed thereon. By scattering spacers (not shown) in a display portion, two substrates 12 are joined with each other at a predetermined interval. Liquid crystal 11 is filled between the substrates and viscosity fluid 13 containing spacers (not shown) is provided as sealing material contacting with the liquid crystal 11. Adhesive resin 14 is coated on the outer side of the viscosity fluid 13 to hold the liquid crystal panel having the two substrates 12.

[0013]

Fig. 2 is a schematic diagram illustrating an example of a method for producing a liquid crystal display panel according to the present invention. First, in the step (a), a transparent electrode and an alignment layer (not shown)

are formed and viscous fluid 22 which is silicon resin (Dow Corning Corporation: high vacuum grease) containing spacers (not shown) is coated onto a substrate 21 so as to surround a display portion. The spacer has a diameter for determining a gap between the liquid crystal panels. The viscous fluid 22 of the silicon resin is not invaded by chemicals and is inert to the liquid crystal. In the step (b), the liquid crystal 24 having the volume equal to that of the space in which the liquid crystal is sealed is dropped in a region surrounded by the viscous fluid 22 using a liquid ejecting apparatus (dispenser) 23. At this time, the liquid crystal material contains spacers (not shown) for forming a gap between the substrates. In the steps (c) and (d), the substrate 21 on which the viscous fluid 22 and the liquid crystal 24 are coated is joined with an opposite substrate 26 in a reduced pressure bath 25 of 0.1 Torr. In the step (e), adhesive resin 28 is coated on the entire outer periphery of the viscous fluid 22 by the dispenser 27. As the adhesive resin for joining the two substrates, cyanoacrylate adhesive (Toagosei chemical Co. Ltd) which is cured at a room temperature and has a short curing time is used. In the step (f), the adhesive resin is cured. Thereby, the liquid crystal display panel of the present invention is completed.

[0014]

In the panel of the present embodiment having the above-mentioned construction, the liquid crystal is not scattered in the interface between the liquid crystal and the sealing material due to the non-cured resin or the light irradiation, which was generated in a conventional method. Also, in the conventional method, a material property such as transition point and specific resistance of the liquid crystal is deteriorated, but, in the present embodiment, a material property of the liquid crystal is not changed. At this time, since the viscous fluid used as the sealing material has fluidity with respect to stress, the gap is easily formed in the joining process. Also, in the conventional method, the amount of the liquid crystal to be dropped must be controlled in precision of ±5%, but, in the present embodiment, the liquid crystal flows out or air void is not generated even in precision of ±10%. Further, in the conventional method, a process of heat-curing the sealing resin or irradiating ultraviolet rays is required, but, in the present embodiment, the curing process is simplified by using the ambient curing adhesive.

[0015]

Further, although the silicon resin is used as the viscous fluid in the present embodiment, fluorocarbon resin (Teflon grease) which is chemically or physically stable may be used. The fluorocarbon resin does not adversely affect

the liquid crystal.

[0016]

Moreover, as the adhesive resin, a phenol adhesive or an epoxy adhesive having strong adhesive force or an adhesive containing solvent having strong influence on the liquid crystal or a reinforcing agent such as a silane coupling agent ca be used. Although the photo-curing type adhesive is used as the adhesive resin, the viscous fluid exists between the photo-curing type resin and the liquid crystal and thus the liquid crystal can be completely masked. Also, the light is not radiated to the liquid crystal and thus is not deteriorated.

[0017]

Furthermore, the adhesive resin having low viscosity can cover the outer periphery of the viscous fluid by capillary tube phenomenon due to the narrow gap between the substrates.

[0018]

As described above, according to the liquid crystal display panel and the producing method of the present invention, by providing the viscous fluid inert to the liquid crystal as the sealing material contacting with the liquid crystal, the liquid crystal is not deteriorated when producing the liquid crystal display panel and thus the reliability of the display characteristics of the liquid

crystal display panel can be enhanced. Moreover, since the liquid crystal is hermetically sealed by the viscous fluid, the margin for controlling the amount of the liquid crystal to be dropped is widened. Further, an adhesive which has strong adhesive force, is cured by a simple curing process, and is harmful to the liquid crystal can be used as the adhesive of the liquid crystal panel and thus the panel having high durability can be produced by a simple process.

[Brief Description of the Drawings]

[Fig. 1]

Fig. 1 is a cross-sectional view of a liquid crystal display panel according to an embodiment of the present invention.

[Fig. 2]

Fig. 2 is a schematic diagram illustrating a method for producing a liquid crystal display panel according to an embodiment of the present invention.

[Fig. 3]

Fig. 3 is a schematic diagram illustrating a method for producing a liquid crystal display panel according to a conventional vacuum injecting method.

[Fig. 4]

Fig. 4 is a schematic diagram illustrating a method for producing a liquid crystal display panel according to a conventional drop injecting method.

[Reference Numerals]

11: liquid crystal

12: substrate

13: viscous fluid

14: adhesive resin

21: substrate

22: viscous fluid

23: dispenser

24: liquid crystal

25: reduced pressure bath

25: opposite substrate

27: dispenser

28: adhesive resin